

## John T. Anderson Engineering Note

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**Project:** Dzero Electrical Support  
**Doc. No:** 1051114  
**Subject:** Support documentation for review of temporary replacement Sequencer power supplies

### ***Introduction***

Inside the Dzero collision hall there is a mixed power supply box (see Dzero note #4777 by J. Olsen) that provides bulk low voltage DC power to both DFE and Sequencer crates. It is based on Vicor DC-DC converter technology. Recent noise issues in the Dzero Calorimeter suggest that the Sequencer portion of this power supply may be generating noise that is picked up by Calorimeter electronics that is adjacent to the Sequencer boards.

As an experiment, the Dzero EE support group has been asked to manufacture a small number of replacement power supplies that are plug-compatible with the existing supplies but that have somewhat increased current capability. To insure compatibility, of course, the replacement supplies are fused at the same level as those they are to replace. The replacements have been fabricated and we formally request that these replacement supplies be inspected and approved for installation into the detector.

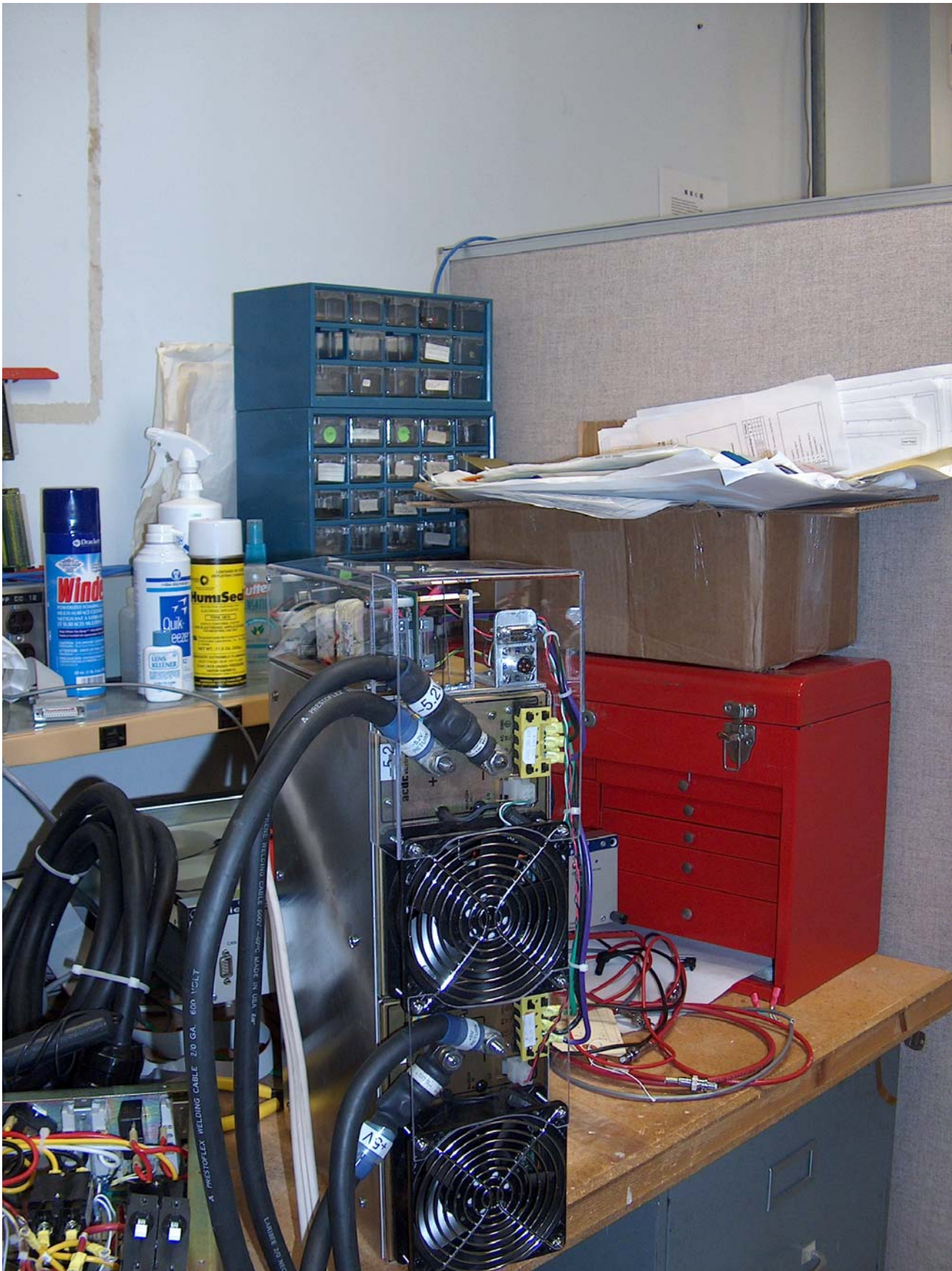
### ***Overall Design of Replacement Supplies***

The replacement Sequencer supplies are intended to act as nearly exact replacements for the existing SEQ supplies. According to the existing documentation, the SEQ supplies are rated at +5V @ 160A and -5.2V @ 80A. The replacement supplies use two ASTEC RSF500 5V@200A power supplies stacked together to emulate this functionality, one for each output voltage. One is margined up to 5.2V. Both are outfitted with pigtail cables made with 1/0 stranded wire. The -5.2V supply output is limited to 80A via an inline fuse at the supply end of the pigtail. The +5V supply is limited to 150A via an inline fuse at the supply end of the pigtail. Figure 1 shows the overall picture.

A small aluminum frame at the top of the supply pair holds two connectors that match the connectivity of the existing SEQ supply for sense contacts and remote control. The small additional supply on top is the +5V supply taken out of a spare RMI module (BiRa p/n8886). It has been modified to use 208VAC input as opposed to 110VAC input and is used to emulate the low-current +5V "AC OK" signal that the Vicor supplies generate. The output current of this supply is primarily limited by the limits of the linear regulator used in its design and secondarily by a series resistor.

The only other differentiation between the replacement supply and the existing supply is that the existing supplies have a dual methodology for turning off the DC power. One control input disables all AC power to all supplies whilst the other leaves the AC power connected but disables the DC outputs of the DC-DC converters. In the replacement supply, the control line to kill the AC power is provided but the secondary shutdown is not. It has been confirmed with Dzero personnel that the normal mode of operation to manually shut down these supplies is to use the AC disable. Of course, in the event of a fault condition, the AC power to the supply is shut down prior to the supply by controlling an AC distribution box. The lack of the secondary control input may affect user convenience but does not compromise safety.

A plastic cover has been fabricated for the small additional supply. It completely encases the small supply and the AC wiring internal to the supply to keep curious fingers and/or conductive debris from coming into contact with hazardous voltages. Additional plastic shields cover the low-voltage, high current output lugs of the main supplies.



**Figure 1 – overall view of replacement supply**



## Wire Harness and Fusing

The existing supply uses Anderson<sup>1</sup> “Power Pole” connectors to deliver the DC voltage to the backplane of the Sequencer crate. Cables terminated in these color-polarized but hermaphroditic connectors plug into their mates on the supply. In our replacements, we have fabricated short (3 foot) pigtails of the same wire gauge that convert from the bulk supply lugs to the appropriate connectors (see figure 2).



**Figure 2**

Note that the gray cable (the -5.2V, 80A circuit) has an inline fuse mounted directly to the supply lug. At the time the picture in Figure 2 was taken, the 150A inline-fused red end pigtail was not available for a photo. However, if the reader will refer back to Figure 1, it can be plainly seen that both DC supplies are fused at the output.

## Feedback and Control

As earlier stated the control of the replacement supply is via the AC disable (pin 8 of the DB9 connector). In the replacement supply this is connected to the inputs of a Crydom D2525D two-pole solid state relay, exactly as in the existing SEQ supply. Disconnecting the cable or failing to drive it with +5V will turn the supply off. Pin 5 of the DB9 connector (the GENERAL SHUTDOWN) input is not connected. Pin 7 of the DB9 connector is driven by the additional small supply, generating a +5V “AC OK” signal. The filter network has been copied.

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<sup>1</sup> No relation to the author of this document.

## ***Internal wiring analysis***

The 208VAC power from the solid state relay is connected using AWG10 wire to a screw-type barrier strip terminal block. Additional AWG10 wires run from the barrier strip to the AC inputs of the two main DC supplies. An additional set of AWG 10 runs from the relay outputs to another pair of 2A fuses, limiting the current to the auxiliary supply. The output of the auxiliary supply is internally limited by the regulator to about 1.5A. Any other external shorts are resistor limited to well less than the ampacity of the internal wiring harness.

## ***Cooling***

The supplies as stacked are sufficiently air-cooled by their internal fans. They have been tested to run at full current when sitting on a bench under standard office temperature conditions at the D0 power supply load test stand.

## ***Additional Documentation***

A full schematic of the supply set is available from the Dzero electrical support group. Supplementary documentation describing the original power supply is available on the web at

[http://www-d0.fnal.gov/d0pub/d0\\_private/4777/m\\_dfe\\_lvps\\_4777.pdf](http://www-d0.fnal.gov/d0pub/d0_private/4777/m_dfe_lvps_4777.pdf)

This web address requires the reader to be a member of the Dzero collaboration. More generic system information is available at

<http://www-d0.fnal.gov/hardware/dfe/>

and

<http://d0server1.fnal.gov/users/utes/>